

56.0503 – Claims as revised- clean version

1. (Amended) A method of treating a subterranean formation, said treatment selected among hydraulic fracturing, acid fracturing and comprising the step of injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection.
2. The method of claim 1 comprising providing a precursor that releases a breaking system by at least one of the following process: melting, slow dissolution, reaction with a compound present in the fluid or added to the fluid during or after the step of injecting, rupture of an encapsulating coating and de-adsorption of a breaking agent absorbed into solid particles.
3. The method of claim 2, wherein said breaking system is selected among at least one of the following salts: ammonium persulfate, potassium chloride, sodium hexafluorophosphate and sodium salicylate and wherein said salts are provided under an encapsulated form.
4. The method of claim 2, wherein said breaking system is a by-product of the reaction of resin-coated proppant.
5. (Amended) The method of claim 2, wherein the breaking system comprises alcohol released from a precursor consisting of at least one of the following: an ester, a carboxylate anion, organic sulfate based salts, and sodium dodecyl sulfate.
6. The method of claim 1, wherein the breaking system comprises a carboxylic acid
7. The method of claim 6, wherein the viscoelastic surfactant is a zwitterionic surfactant and the breaking system is citric acid.
8. The method of claim 2, wherein the breaker system comprises a carboxylic acid released from a precursor comprising a carboxylate anion, said released being performed after lowering of the pH of the viscoelastic surfactant fluid through hydrolysis of an ester.
9. The method of claim 2, wherein the breaking system is released by melting a precursor, said precursor consisting of at least one of the following: a C₁₂ to C₁₈ alcohol, alkyl amines, alkanes, alkenes, aromatics and mixtures thereof.

10. The method of claim 2, wherein the viscoelastic surfactant is anionic and/or cationic and the breaking system is released by dissolution of at least a surfactant having hydrophilic headgroups oppositely charged to the hydrophilic headgroups of the anionic or cationic surfactants of the viscoelastic surfactant fluid.
11. The method of claim 5, wherein the breaking system is at least one of the followings: an alkyl sulfate, an ether sulfate, an alkyl halide, a carboxylic acid, a carboxylic acid salt, an alkyl phosphate, an aryl phosphate or mixture thereof.
12. The method of claim 11, wherein said breaker is a C₁₈ to C₂₀ alkyl sulfate or mixture thereof.
13. The method of claim 9, wherein the breaking system is released by slow dissolution and is at least one of the followings: alkyl amines; alkanes, alkenes and aromatics.
14. The method of claim 13, wherein the breaking system is dodecyl amine.
15. (Amended) The method of claim 1, wherein the breaking system or the precursor of the breaking system is provided in the form of nanoparticles.
16. (Amended) The method of claim 1, wherein the breaking system comprises alcohol.
17. The method of claim 16, wherein said alcohol is methanol or ethanol.
18. The method of claim 1, wherein the breaking system reduces low shear viscosity.
19. The method of claim 20, wherein the breaking system does not substantially reduce high shear viscosity
20. (Amended) A method of treating a subterranean formation, said treatment selected among hydraulic fracturing, acid fracturing and comprising the step of injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a breaking system or a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection, wherein the breaking system reduces the low shear viscosity and is added to the viscoelastic fluid during the pad or the pre-pad stage.
21. The method of claim 19, wherein the breaking system is added to the viscoelastic fluid during the pad or the pre-pad stage.
22. (Amended) A method of treating a subterranean formation by first injecting, down a well, a solid-free aqueous fluid comprising a thickening amount of a cationic viscoelastic surfactant

and an alcohol, selected among methanol and ethanol, and then, a proppant-containing aqueous fluid comprising a thickening amount of said cationic viscoelastic surfactant.

23. The method of claim 22, wherein the cationic viscoelastic surfactant is erucyl methyl bis(2-hydroxyethyl) ammonium chloride.
24. The method of claim 1, wherein said treatment consists of at least one of the following: gravel packing, hydraulic fracturing, acid fracturing and acidizing.
25. The method of claim 1, wherein said breaker is added to only a portion of said viscoelastic surfactant fluid.
26. The method of claim 1, wherein said viscoelastic surfactant is anionic, cationic, nonionic, zwitterionic or a combination thereof.
27. (Cancelled)
28. (Cancelled)
29. (Amended) A composition for treating a subterranean formation comprising an aqueous fluid comprising a thickening amount of a viscoelastic surfactant and a precursor of a breaking system that causes a reduction in viscosity of the fluid, said precursor of the breaking system comprising resin-coated proppant.
30. (Cancelled)
31. (Cancelled)
32. (Cancelled).
33. (Amended) A composition for treating a subterranean formation comprising an aqueous fluid comprising a thickening amount of a viscoelastic surfactant and a precursor of a breaking system that causes a reduction in viscosity of the fluid, said precursor of the breaking system comprising at least one of the following: a C₁₂ to C₁₈ alcohol, alkyl amines, alkanes, alkenes, aromatics and mixtures thereof.
34. (Amended) A composition for treating a subterranean formation comprising an aqueous fluid comprising a thickening amount of an anionic and/or cationic viscoelastic surfactant and a precursor of a breaking system that causes a reduction in viscosity of the fluid, said precursor of the breaking system being a slow-soluble surfactant having hydrophilic

headgroups oppositely charged to the hydrophilic headgroups of the anionic or cationic surfactants of the viscoelastic surfactant fluid.

35. (Amended) A composition for treating a subterranean formation comprising an aqueous fluid comprising a thickening amount of a viscoelastic surfactant and a precursor of a breaking system that causes a reduction in viscosity of the fluid, said precursor of the breaker system being provided in the form of nanoparticles.
36. (Cancelled)
37. (New) A method of treating a subterranean formation by injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection, wherein said breaking system is a by-product of the reaction of resin-coated proppant.
38. (New) A method of treating a subterranean formation by injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection, wherein said precursor releases the breaking system by at least one of the following process: melting, slow dissolution, reaction with a compound present in the fluid or added to the fluid during or after the step of injecting, rupture of an encapsulating coating and de-adsorption of a breaking agent absorbed into solid particles and wherein the wherein the breaking system comprises alcohol released from a precursor consisting of at least of one of the following: an ester, a carboxylate anion, organic sulfate based salts, and sodium dodecyl sulfate.
39. (New) A method of treating a subterranean formation by injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a precursor of a breaking system, said breaking comprising a carboxylic acid and causing a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection.
40. (New) The method of claim 39, wherein the viscoelastic surfactant is a zwitterionic surfactant and the breaking system is citric acid.

41. (New) The method of claim 39 wherein the carboxylic acid is released from a precursor comprising a carboxylate anion, said released being performed after lowering of the pH of the viscoelastic surfactant fluid through hydrolysis of an ester.
42. (New) A method of treating a subterranean formation by injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection., said breaking system released by melting a precursor, said precursor consisting of at least one of the following: a C₁₂ to C₁₈ alcohol, alkyl amines, alkanes, alkenes, aromatics and mixtures thereof.
43. (New) A method of treating a subterranean formation by injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic anionic and/or cationic surfactant comprising providing a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection., said breaking system released by dissolution of at least a surfactant having hydrophilic headgroups oppositely charged to the hydrophilic headgroups of the anionic or cationic surfactants of the viscoelastic surfactant fluid.
44. (New) The method of claim 38, wherein the breaking system is at least one of the followings: an alkyl sulfate, an ether sulfate, an alkyl halide, a carboxylic acid, a carboxylic acid salt, an alkyl phosphate, an aryl phosphate or mixture thereof.
45. (New) The method of claim 44, wherein said breaker is a C₁₈ to C₂₀ alkyl sulfate or mixture thereof.
46. (New) The method of claim 42, wherein the breaking system is released by slow dissolution and is at least one of the followings: alkyl amines; alkanes, alkenes and aromatics.
47. (New) The method of claim 46, wherein the breaking system is dodecyl amine.
48. (New) A method of treating a subterranean formation by injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a breaking system or a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and

during the injection., said breaking system , wherein the breaker system or the precursor of the breaker system is provided in the form of nanoparticles.

49. (New) A method of treating a subterranean formation by injecting down a well an aqueous fluid comprising a thickening amount of a viscoelastic surfactant comprising providing a breaking system or a precursor of a breaking system that causes a reduction in viscosity of the fluid after its injection but does not significantly impact its viscosity at surface and during the injection, said breaking system comprising alcohol.

50. (New) The method of claim 16, wherein said alcohol is methanol or ethanol.